Control of Golden Crownbeard (*Verbesina encelioides*) in Peanut (*Arachis hypogaea*) with Postemergence Herbicides[1]

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ABSTRACT

Field experiments at five South Texas locations from 1992 to 1995 evaluated eight postemergence herbicides alone or in combination for golden crownbeard control and peanut yield. Imazapic provided inconsistent golden crownbeard control regardless of rate. Bentazon and 2,4-DB alone controlled ≥ 90% golden crownbeard while acifluorfen at 0.42 kg/ha and pyridate provided ≥ 80% control. Bromoxynil and imazethapyr alone or acifluorfen plus bentazon provided inconsistent golden crownbeard control.

Key Words: Groundnut, over-the-top herbicides, yellowtop.

Peanut presents several unique features that contribute to broadleaf weeds escaping control. First, most peanut cultivars grown in the U.S. require a fairly long growing season—approximately 140 to 160 d—depending on cultivar and geographical region (Henning *et al.*, 1982; Wilcut *et al.*, 1994b). This long growing season allows more time for soil-applied herbicides to degrade and broadleaf weeds to infest peanut. Secondly, peanut has a prostrate growth habit and a relatively shallow canopy, compared to many broadleaf crops, that is slow to shade row middles allowing weeds to be more competitive with peanut (Walker *et al.*, 1989; Wilcut *et al.*, 1995). Additionally, peanut fruits develop underground on pegs which originate from stems that grow along the soil surface. The prostrate growth habit and pattern of fruit development restricts cultivation to an early season control option (Brecke and Colvin, 1991; Wilcut *et al.*, 1994b, 1995).

Golden crownbeard [*Verbesina encelioides* (Cav.) Benth. & Hook f. ex Gray], also known as yellowtop or cowpen daisy, is a summer annual which is native to America (Correll and Johnston, 1979). It is found in the warmer regions of the United States (Correll and Johnston, 1979), including Hawaii (Yudin *et al.*, 1986). Golden crownbeard grows up to 1 m tall and is multibranched with grayish-green leaves. It can be found in the southern, central, and parts of the eastern Texas peanut-growing region (author's pers. observ.). Golden crownbeard can be found also in parts of the Oklahoma peanut-growing region (R. Sholar, pers. commun.).

Golden crownbeard is considered a troublesome weed, not only for innate competitive abilities, but also for toxins in the foliage. The level of galegine in golden crownbeard is toxic to sheep, compromising respiration, causing hemorrhaging in the heart, and ultimately resulting in death (Keeler *et al.*, 1992).

Golden crownbeard can be found growing in the south Texas area during the entire year if winter conditions are mild. Since this weed can survive almost year around, golden crownbeard may serve as a host for thrips which help in the spread of spotted wilt disease caused by tomato spotted wilt virus (TSWV). TSWV is a tospovirus, a group vectored by at least nine species of thrips (Ger-

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man *et al.*, 1992; Hunter *et al.*, 1995). Two of these, *Franklinella fusca* Hinds (the tobacco thrips) and *F. occidentalis* Pergande (the western flower thrips), are the primary species associated with south Texas peanut (Mitchell *et al.*, 1990).

Golden crownbeard can be controlled with many of the soil-applied herbicides registered for use on peanut, but there is limited information available on the postemergence (POST) control of golden crownbeard in peanut and peanut yield response. Weed escapes do occur, and information is needed on the use of POST herbicides for control of golden crownbeard. Therefore, studies were initiated to evaluate the performance of selected POST herbicides for golden crownbeard control in peanut.

Materials and Methods

Field experiments were conducted in 1992, 1994, and 1995 on a grower's field near Pearsall, TX; and in 1994 and 1995 on a grower's field near Charlotte, TX. No site with sufficient golden crownbeard infestation could be located for a trial in 1993. Soil at the Pearsall locations were Duval loamy fine sand (fine-loamy, mixed, hyperthermic Aridic Haplustalfs) with less than 1% organic matter and a pH of 6.8 to 7.2. Soils at the Charlotte locations were Nueces loam fine sand (loamy, mixed, hyperthermic Aqiuc Arenic Palenstalfs) with less than 1% organic matter and a pH of 7.0 to 7.2.

The experimental design for all locations was a randomized complete block with three or four replications. Each plot contained two rows, 97 cm apart and 7.6 m long. The Pearsall locations in 1992 and 1995 were infested with moderate levels of golden crownbeard (4 to 6 plants/m^2) while in 1994 the golden crownbeard population was light to moderate (< 4 plants/m^2). The Charlotte sites were infested with heavy golden crownbeard populations in both 1994 and 1995 (> 8 plants/m^2).

A schedule of events for conducting this study and list of herbicide treatment are shown in Tables 1 and 2. Cultivar GK-7 peanut was planted in all trials at 95 kg/ha, 5-cm deep on a raised seedbed using conventional equipment. No soil-applied herbicides were used at planting. Sethoxydim [2-[-1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] was used POST to control escaped Texas panicum (*Panicum texanum* Buckl.) and southern crabgrass [*Digitaria ciliaris* (Retz.) Koel.]. At the Pearsall location, plots were irrigated on a 10- to 14-d schedule as needed throughout the growing season. At the Charlotte location, plots were irrigated beginning when peanut were approximately 60 d old; and on a 14- to 21-d interval between irrigations.

Table 1. Schedule of events for golden crownbeard control studies in peanut, 1992-1995.

	Treatment years and location				
	1992	1994		1995	
Events	Pearsall	Charlotte	Pearsall	Charlotte	Pearsall
Peanuts planted	19 May	28 June	26 Apr	19 June	19 May
POST trt. applied	23 June	21 July	17 May	25 July	12 June
Weed height at trt.	<10 cm	>15 cm	<10 cm	>15 cm	>15 cm
Weed pressure	Moderate	High	Light	High	Moderate
Peanuts dug	1 Oct	15 Nov	15 Sept	1 Nov	7 Oct
Peanuts combined	7 Oct	21 Nov	20 Sept	6 Nov	15 Oct

All POST herbicides were applied 3 to 5 wk after peanut planting. Herbicides were applied with a compressed-air bicycle sprayer through flat fan nozzle tips (Spraying Systems Co., Wheaton, IL) which delivered a spray volume of 190 L/ha at 180 kPa. Data collected included visual estimates of crop injury and weed control on a scale of 0% (no control or peanut injury) to 100% (complete weed control or death of the peanut plants) relative to the untreated check. Weed control and peanut injury were visually estimated early, mid-, and late season during each year.

Peanut yields were obtained by digging each plot separately, air-curing in the field for 5 to 8 d, and harvesting peanut pods from each plot with a peanut combine. Weights were recorded after soil and foreign material were removed from the plot samples. Weed control data were subjected to arcsine transformation prior to analysis of variance, and original data were used for presentation. Peanut yields were subjected to analysis of variance. Significant differences among means for weed control data and peanut yield were determined using Fisher's Protected LSD Test (P = 0.05). Since not all treatments were included at each location due to test area constraints, data were presented separately for each year.

Results and Discussion

Peanut Injury. Peanut stunting was less than 10% with all imazapic and imazethapyr treatments when rated 6 wk after POST applications (data not shown). Chlorosis due to imazapic and imazethapyr was noticeable for 10 to 14 d after POST application but was not evident 28 d after application (data not shown). Bromoxynil stunted peanut and caused foliar necrosis both years; this injury was visible up until harvest (data not shown).

Golden Crownbeard Control. All herbicide treatments except acifluorfen plus bentazon controlled golden crownbeard better than 90% at Pearsall in 1992 (Table 3). Acifluorfen plus bentazon provided 85% golden crownbeard control. As the rate of acifluorfen, imazapic, or pyridate increased, golden crownbeard control did not always increase. However, increasing the rate of imazethapyr from 0.05 to 0.07 kg/ha increased golden crownbeard control. The addition of 2,4-DB to either acifluorfen or pyridate did not improve golden crownbeard control over acifluorfen or pyridate alone and is inconsistent with current herbicide use trends in peanut. Many POST herbicides are applied in mixture with 2,4-DB to improve control of many other broadleaf species (Wilcut *et al.*, 1994b, 1995). Our data show no benefit of tank mixing 2,4-DB with either acifluorfen or pyridate for golden crownbeard control.

In 1994 at Charlotte, acifluorfen at 0.56 kg/ha; bromoxynil, lactofen, pyridate at 1.0 kg/ha; and pyridate at 1.0 kg/ha plus 2,4-DB effectively controlled golden crownbeard while 2,4-DB alone controlled 90% golden crownbeard (Table 3). Imazapic and imazethapyr were less efficacious. Golden crownbeard control with either imazapic or imazethapyr may be affected by the amount and frequency of rainfall soon after application (Richburg

Table 2. Herbicide treatments for golden crownbeard control studies in peanut, 1992-1995.

Common name	Chemical name	Rate	Adjuvant
		kg/ha	
Acifluorfen	5-[2-chloro-4-(trifluoromethyl) phenoxy]-2-nitrobenzoic acid	0.42, 0.56	Crop oil concentrate[a] (1% v/v)
Acifluorfen + bentazon	A mixture of 159 g acifluorfen and 320 g bentazon/L[b]	0.28 + 0.56	Crop oil concentrate (1% v/v)
Acifluorfen + 2,4-DB	-	0.56 + 0.28	Crop oil concentrate (1% v/v)
Bentazon	3-(1-methylethyl)-(1*H*)-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide	1.12	Crop oil concentrate (1% v/v)
Bromoxynil	3,5-dibromo-4-hydroxybenzonitrile	0.28	None
Imazethapyr	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid	0.05, 0.07	Nonionic surfactant[c] (0.25% v/v)
Imazapic	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyrindine- carboxylic acid	0.04, 0.05, 0.06, 0.07	Nonionic surfactant (0.25% v/v)
Lactofen	(±)-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl) phenoxy]-2-nitrobenzoate	0.28	Crop oil concentrate (0.5% v/v)
Pyridate	*O*-(6-chloro-3-phenyl-4-pyridazinyl)*S*-octyl carbonothioate	0.5, 1.0	Crop oil concentrate (1% v/v)
Pyridate + 2,4-DB	-	0.50 + 0.28, 1.0 + 0.28	Crop oil concentrate (1% v/v)
2,4-DB	4-(2,4-dichlorophenoxy)butanoic acid	0.28	Crop oil concentrate (1% v/v)

[a]Agridex, a crop oil concentrate containing 83% paraffin based petroleum oil and 17% polyoxyethylated polyol fatty acid and polyol fatty acid ester (Helena Chemical Company, Memphis, TN).

[b]A premix marketed as Storm (BASF Corp., Parsippany, NJ).

[c]X-77, a nonionic surfactant containing alkylanylpolyethylene glycols, free fatty acids, and isopropanol (Valent USA, San Ramon, CA).

Table 3. Late-season golden crownbeard control in peanut with postemergence herbicides, 1992-1995.

		Control				
		1992	1994		1995	
Treatment	Rate	Pearsall	Charlotte	Pearsall	Charlotte	Pearsall
	kg/ha	%	------%		------%	
Nontreated check	-	0	0	0	0	0
Acifluorfen	0.42	93	-	100	-	80
Acifluorfen	0.56	95	100	100	55	-
Acifluorfen + 2,4-DB	0.56 + 0.28	95	-	100	-	98
Acifluorfen + bentazon	0.28 + 0.56	85	88	100	60	90
Bentazon	1.12	96	-	-	-	100
Bromoxynil	0.28	-	100	-	66	-
Imazapic	0.04	93	78	90	43	28
Imazapic	0.05	97	75	100	40	27
Imazapic	0.06	94	60	93	60	-
Imazapic	0.07	92	87	100	38	27
Imazethapyr	0.05	90	-	83	-	-
Imazethapyr	0.07	95	67	87	35	7
Lactofen	0.28	95	100	100	80	94
Pyridate	0.50	92	-	100	-	-
Pyridate	1.00	94	100	100	98	88
Pyridate + 2,4-DB	0.50 + 0.28	95	-	100	100	-
Pyridate + 2,4-DB	1.00 + 0.28	-	100	-	100	92
2,4-DB	0.28	91	90	100	100	98
LSD (0.05)		5	29	11	19	31

et al., 1993, 1995; Wilcut *et al.*, 1994a). The Charlotte location received only 25.4 mm of rainfall during the first 30 d after POST applications and the plants were under some drought stress. Richburg *et al.* (1995) speculated that drought-stressed Florida beggarweed [*Desmodium tortuosum* (SW.) DC.] was more tolerant to imazapic than plants that are actively growing with adequate soil moisture.

In 1994 at Pearsall, golden crownbeard control with imazapic ranged from 90 to 100% while imazethapyr efficacy was less, ranging from 83 to 87% (Table 3). Acifluorfen, acifluorfen plus bentazon, acifluorfen plus 2,4-DB, lactofen, pyridate, and pyridate plus 2,4-DB controlled golden crownbeard 100%.

At Charlotte in 1995, imazapic, acifluorfen, acifluorfen plus bentazon, bromoxynil, and imazethapyr failed to adequately control golden crownbeard (Table 3). As in 1994, only a small amount of rainfall (12.5 mm) was received at the test location for approximately 30 d after POST application. Richburg *et al.* (1995) noted that under low rainfall amounts less yellow nutsedge root absorption of imazapic and imazethapyr occurred and consequently less yellow nutsedge control was observed. This also may have occurred with imazapic and imazethapyr under the drought conditions in our trials affecting golden crownbeard control. Pyridate, 2,4-DB, or pyridate plus 2,4-DB controlled yellowtop ≥ 98% while lactofen controlled yellowtop 80%. Jordan *et al.* (1993) reported that POST systems which included a minimum of one application of lactofen provided essentially complete control of eclipta (*Eclipta prostrata* L.).

In 1995 at Pearsall, bentazon provided excellent golden crownbeard control while golden crownbeard control with imazapic was ≤ 30% regardless of rate. Irrigation was applied on a regular schedule and 76.2 mm of irrigation/rainfall was received at this location for 30 d after planting. Acifluorfen plus bentazon, aciflurofen plus 2,4-DB, lactofen, pyridate plus 2,4-DB and 2,4-DB alone controlled ≥ 90% golden crownbeard.

At the time of herbicide application at Pearsall, golden crownbeard plants were 15 cm tall. This may have caused the poor golden crownbeard control with imazapic and imazethapyr. Richburg *et al.* (1995) reported that applications of imazapic and imazethapyr to bristly starbur (*Acanthospermum hispidum* DC.) plants taller than 4 cm killed only the terminal stem and the plant recovered rapidly.

Peanut Yield. In 1992, all herbicide treatments increased peanut yields by 17 to 51% as compared to the untreated control (Table 4). Imazapic at 0.05 kg/ha increased yields 50% as compared to the control.

In 1994 at Charlotte, all rates of imazapic, imazethapyr, pyridate, 2,4-DB, and pyridate plus 2,4-DB improved peanut yield over the untreated check by 32 to 70%. The improved yield with imazapic and imazethapyr may be partially attributed to superior yellow nutsedge (*Cyperus esculentus* L.) control. Previous studies have documented the excellent control of yellow nutsedge with imazapic and imazethapyr (Grichar, 1992; Grichar *et al.*, 1992; Wilcut *et al.*, 1994a; Richburg *et al.*, 1995). In 1994 at Pearsall, imazapic and imazethapyr increased peanut yield by 96 to 200% over the untreated control. A severe late season infection by southern blight (*Sclerotium rolfsii* Sacc.) in some plots may have resulted in peanut pod loss which confounded yield response to golden crownbeard control.

In 1995 at Charlotte, imazapic at 0.04 and 0.06 kg/ha; acifluorfen at 0.56 kg/ha; imazethapyr, pyridate at 1.0 kg/ha; and pyridate plus 2,4-DB increased yield 840 to 1530 kg/ha over the untreated control (Table 4). At Pearsall in

Table 4. Peanut yield from South Texas locations, 1992-1995.

Treatment	Rate	1992	1994		1995	
		Pearsall	Charlotte	Pearsall	Charlotte	Pearsall
	kg/ha	kg/ha	------kg/ha-----		------kg/ha------	
Nontreated check	-	3320	2120	840	920	480
Imazapic	0.04	4160	3230	1760	2070	630
Imazapic	0.05	5010	3180	2220	1530	980
Imazapic	0.06	4760	3610	2540	2110	-
Imazapic	0.07	4940	2800	1970	1430	1250
Acifluorfen	0.42	4240	-	1510	-	820
Acifluorfen	0.56	4560	2420	1260	1760	-
Acifluorfen + 2,4-DB	0.56 + 0.28	4100	-	1260	-	1050
Acifluorfen + bentazon	0.28 + 0.56	4360	2490	1020	1590	810
Bentazon	1.12	3890	-	-	-	1100
Bromoxynil	0.28	-	2180	-	1730	-
Imazethapyr	0.05	4290	-	1650	-	-
Imazethapyr	0.07	4880	3460	1770	1960	-
Lactofen	0.28	4460	2260	1570	2052	580
Pyridate	0.50	4680	-	1040	-	-
Pyridate	1.00	4600	3020	1440	2150	650
Pyridate + 2,4-DB	1.00 + 0.28	4460	-	1140	2450	-
Pyridate + 2,4-DB	1.00 + 0.28	-	3320	1060	1950	560
2,4-DB	0.28	3990	3070	1140	1480	510
LSD (0.05)		1210	660	810	840	660

1995, only imazapic increased yield over the untreated control. Low yields were obtained from the Pearsall location due to populations of Palmer amaranth (*Amaranthus palmeri* S. Wats) and sicklepod [(*Senna obtusifolia*) (L.) Irwin and Barneby] which were prevalent throughout the test area.

These field studies indicate that imazapic and imazethapyr provide sporadic control of golden crownbeard especially under variable moisture conditions and large weed size. Bentazon, lactofen, pyridate, 2,4-DB, and acifluorfen or pyridate plus 2,4-DB were the best options for POST golden crownbeard control.

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